

REPORT ON THE SAMPLING FOR SEED OF NATIVE PINE POPULATIONS IN NINE ZONES DURING
JANUARY TO APRIL 1987

DISCUSSION: In 1975 a discussion paper headed "The gene pool of Caledonian Scots Pine - *Pinus sylvestris* L. Its conservation and Uses" was presented by Roy Faulkner at the symposium held at Aviemore organised by NERC and entitled NATIVE PINWOODS OF SCOTLAND. (p.96 - [7])

Following this symposium the Genetics Branch breeding programme for Scots Pine included in its objectives the need to establish 4ha seedling seed plantations derived from each of the major native pine zones.

The gene pools thus created will ensure the conservation of each of the major zones and at the same time provide a reasonably wide genetic base from which plants can then be raised to furnish material for artificial regeneration and possible future selection for breeding.

In September 1986 the decision was made to undertake seed collections in the early part of 1987. Eight major zones were considered with one population in each selected for sampling. The zone and selection being based on the work of G I Forrest (Genotypic variation among native Scots Pine populations in Scotland based on Monoterpene Analysis - Forestry, Vol. 53 No. 2, 1980).

POPULATIONS: The following populations were selected for sampling:-

	<u>Owner</u>	<u>Map ref.</u>	<u>Zone</u>
1) Cougie	FC	NH/230200	Strath Glass
2) Achnashellach	FC		East Wester Ross
a) Glencarron		NH/505059	
b) Glenuig		NH/488060	
c) Golden Valley		NH/467008	
3) Queens (Green Loch)	FC	NH/995104	Speyside
4) Shieldaig	Mr A C Greg	NG/823525	Wester Ross
5) Strathvaich	Smiths Gore (Agents)	NH/343767	Northern
6) Conaglen	Mr Guthrie	NM/960714	Great Glen
7) Glen Tanar	Mrs Bruce	NO/463936	Deeside
8) Rannoch	FC	NN/580560	Rannoch Moor

METHODS AND SAMPLING PROCEDURE: The sampling method to be employed was to have been on a transect from high to low elevation across each population collecting 10 cones from each nth tree. However in the event this proved impractical in the main for three reasons:-

1. Variable stocking
2. Difficult terrain

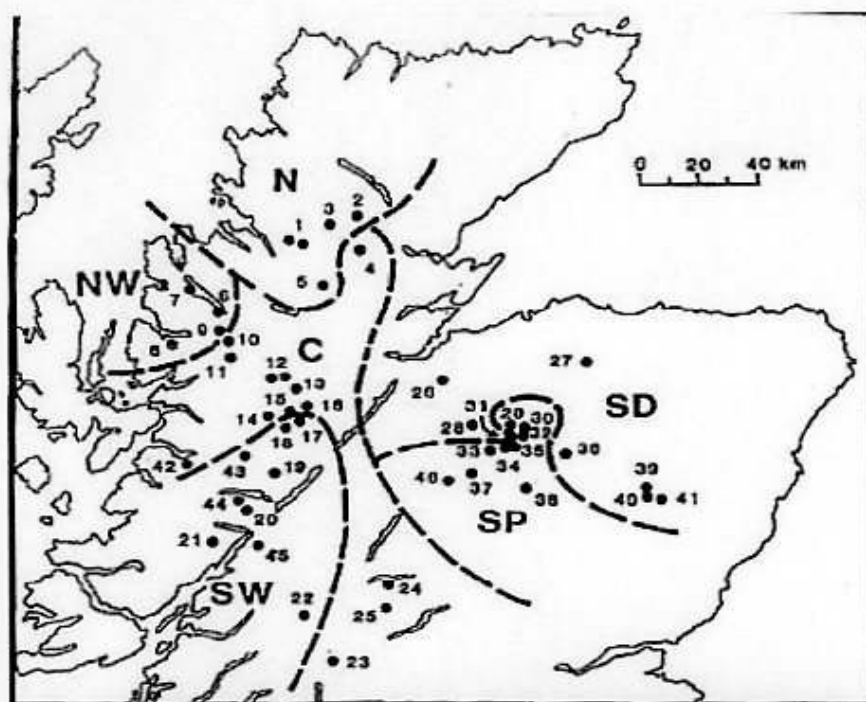


Fig. 1—Division of natural range of Scots pine into regions of biochemical similarity

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|-------------------------|---------------------------|
| 1. Rhidorroch | 24. Rannoch |
| 2. Strath Oyckell | 25. Meggernie |
| 3. Glen Einig | 26. Meallmore |
| 4. Amat | 27. Elchies |
| 5. Strath Vaich | 28. Dalnahaunnach |
| 6. Loch Maree | 29. Abernethy—Loch Garten |
| 7. Eilean Ruairidh Mor | 30. Abernethy—Fairy Tree |
| 8. Shieldaig | 31. Abernethy—Torchill |
| 9. Coulin—Loch Clair | 32. Abernethy—Cuchanlupe |
| 10. Coulin—Easan Dorcha | 33. Rothiemurchus |
| 11. Achnashellach | 34. Queen's—Loch Morlich |
| 12. Glen Strathfarrar | 35. Queen's—Glenmore |
| 13. Glen Cannich | 36. Glen Avon |
| 14. Glen Affric—West | 37. Glen Feshie |
| 15. Glen Affric—Central | 38. Mar—Glen Derry |
| 16. Glen Affric—East | 39. Glentanar—Tanar |
| 17. Guisachan | 40. Glentanar—Gairney |
| 18. Cougie | 41. Glentanar—Allachy |
| 19. Glengarry | 42. Barrisdale |
| 20. Glen Loy | 43. Glen Loyne |
| 21. Ardour | 44. Glen Mullie |
| 22. Black Mount | 45. Glen Nevis |
| 23. Glen Falloch | 46. Glen Tromie |

TABLE 2
SAMPLE DATA

Pinewood	1987 Collection Date	No. of Sample Trees	Total Cones	No. of Pure Seed	No. of Seed/ Cone	Mean Days	Area Ha	I.N.	Seed Extracted At
Cougie	January	130	2983	4578	1.6	4.50	43	86(10)901	Fort Augustus
Achnashellach	January	84	1920	6636	3.5	3.50	22	86(10)902	Fort Augustus
Queen's	January	154	2969	6790	2.2	6.00	122	86(20)902	Fort Augustus
Shieldaig	February	204	4145	27245	6.6	3.50	75	86(10)900	NRS
Strathvaich	February	153	3100	8369	2.9	7.00	38	86(10)903	Fort Augustus
Conaglen	March	168	3912	21287	5.4	3.75	250	86(10)903	Fort Augustus
Glen Tanar	March	246	5373	23001	4.3	4.00	1734	86(20)901	NRS
Rannoch	March	152	4024	23662	5.9	2.50	891	86(20)900	NRS
Barrisdale	April	60	527	3142	5.5	3.00	60	86(10)904	Fort Augustus

3. Very variable cone crops

- a) between populations
- b) between trees
- c) between sites

Actual sampling was to the following pattern:

1. Transects modified by terrain
2. Transects high to mid and low elevations, across populations
3. In very large pine woods such as Glen Tanar one transect was employed in each of the 4 major widely dispersed areas
4. Every tree on the transect line with cones was sampled as so few trees had any cones at all (this varied considerably according to site or elevation in particular)
5. 10 to 30 cones collected per tree, at approximately mid crown.

EQUIPMENT: Basic essential equipment for the collections which can if necessary be handled by one man is as follows:

1. Heavy duty pole pruner with 3-4 sections (with reach 8m approx.)
2. Shotgun with LG cartridges
3. Rucksack for holding cones and shot.

COLLECTIONS/REPORTS

I COUGIE (BARRACH WOOD - FC)

This is a comparatively small but well stocked reserve of some 43ha, completely surrounded by P67 to P71 plantings of mainly LP and SS with smaller amounts of SP, NS, JL and HL. According to the RI records only Affric SP was used in the young plantings, but there is no indication as to what part of Affric the seed came from. The nearest comparable neighbouring pine of the same assumed vintage and origin lies almost 2km to the East at Leicir Beithe where the trees are more scattered and are interplanted with SS and LP.

Isolation: Contamination is thought to be very low, the nearest suspected source is from the east at a distance of at least 3 - 4 km. Cross pollination within the population is good.

Regeneration: Very little regeneration seen, but the stand itself is healthy and of an age capable of good seed bearing. Grazing is no doubt a factor here and further internal fencing is required.

Sampling: (130 trees) Due to a very poor cone crop the sampling had to be every tree encountered with a minimum of 10 cones and even with 7 "zigzag" transects only 130 trees could be sampled which gave an extremely low seed yield of 4678 sound seeds and 2.4 seeds/cone.

There are very real practical difficulties in sampling every tree or every nth tree for two main reasons, and both concern the taller trees in the population:

- 1) Where cones are borne high up on the inner parts of spire crowns or on the top of rounder crown types beyond the reach of pruners then even with shooting it becomes almost impossible to get the branches to fall through without lodging;
- 2) Again where very sparse cone crops occur beyond pruner reach shooting becomes very expensive at one (or more) shots for each of 10 scattered individual cones.

The point being made of course is that out of practical necessity one is being biased on a number of counts. Consideration will be given to this problem in the Summary.

Recommendation: In the long term in order to ensure continuation of the population by regeneration an internal deer fence is essential which could even include and link up with the easterly Leitir Beithe woodland which is largely interplanted with SS or LP but which could be allowed to 'mature' and then harvested leaving the whole area to return to native woodland.

II ACHNASHELLACH (FC)

Three main woodlands were sampled each well separated by distances of between 1.5 and 4km. A fourth remnant has been recorded by Steven & Carlisle at Allt Coir a Bhainidh but this was not sampled.

Each of the 3 seed lots were kept separate but can probably be bulked as being most likely of the same distinct origin.

A. Glencarron

The most easterly of the groups occurs here crossing the FC boundary, half in FC and approximately half on private ground. Strangely enough this woodland is not mentioned by Steven & Carlisle though it has every appearance of being natural native. The age of this wood is unknown but many of the trees are unhealthy with sparse foliage, usually a sign of considerable age. Age structure appears to be even and it may be assumed that without regeneration the population is likely to disappear within the next 40 to 50 years.

Isolation: Scattered plantings of SP from 1923-29 of unknown origin lie within 200m to 800m in an arc NW to SE but because of the scattered and often in-mixture nature of these plantings and distances involved it is not thought that contamination is too much of a problem.

Regeneration: Almost all this woodland is outside the deer fence though the FC boundary passed through more or less the centre of the area and because of this and a large red deer presence there is practically no natural regeneration. However outside the deer fence in Compt 2025c there is a considerable area of what is believed to be natural regeneration of some 40 years of age resulting from a fire of that era. Prior to this there were scattered old pine throughout the area in which the regeneration occurred.

Sampling: A very poor cone crop resulted in only 37 trees sampled.

Recommendation: Deer fence whole area (in co-operation with private owner if interested).

Accept regenerated area as a valuable extension to the native reserve.

NOTE: Shoot samples have been collected from this regeneration for monoterpene analysis for further confirmation of its suspected local origin. Contamination from the NW (200m) could be removed by felling and replacement with native (local) origin SP or other species.

B. Glenuig (Stoc Mor)

This old native remnant is in an advanced state of decline, many of the trees are dead and the majority have very sparse foliage. My first visit to this wood was

in 1954/55 (with Michael Edwards and Angus MacDonald) when most of the trees certainly looked very much healthier than they do today, so perhaps we might assume that another 30 odd years will see few trees left alive. The age of the wood is probably well over 200 years and near the maximum average life span. A note written by G Bartlett on 19/12/49 gives the age on a ring count at that time of 219 years.

Isolation: P28 - 29 SP of unknown origin occurs in an arc West to East and within 150m to 300m. This almost certainly provides a source of contamination of unacceptable proportions. Age and lack of flowering may have a serious effect on pollination within this small population.

Regeneration: Very little regeneration seen, apart from the old fenced-in (now broken down) plot in the centre of the area.

Sampling: Very poor sample, only 11 trees with collectable amounts of cones in the whole area, sample produced only 5-20 cones per tree.

Recommendations:

- (i) Introduce native planting stock, and/or accept what little natural regeneration there is - in the latter case some limited hand weeding would be necessary;
- ii) Check if internal deer fence is necessary;
- iii) Remove contaminant sources by felling.

C. Golden Valley (Coire Leirigh) (managed Conservation Reserve)

According to Steven & Carlisle's map there was at the time of their study a much larger area of predominantly native and natural pine and this applied to the Glenuig area also.

Of the three areas this is the best in terms of health, stocking, size of area, cone crop and regeneration and its future conservation is also assured by a recent new deer fence, enclosing the reserve itself.

Isolation: There is a small area of P38 SP 100m north and a mixture area of SS/LP/SP north to northwest. The origin of this SP has not been checked against the Ri records but if found not to be of local origin then consideration should be given to felling. A further area of mixed SP/SS also at 100m, but to the west, could be a contaminant source. These mixture areas would be worth checking on the ground as in many cases the SS component may well have killed off the SP. There are no contamination sources SE to SW. Within population cross pollination should be good

Regeneration: There is a scatter of regeneration throughout the area and there is little doubt that more will appear and survive now that the new deer fence is in position.

Sampling: Due to a much improved cone crop compared with the last two reserves 2 transects up and down the steep slopes gave 52 trees sampled.

Recommendations: Weeding occasionally in rank heather. Cut out contaminant sources.

III QUEENS - GLENMORE - GREEN LOCH AREA (FC - SWT)

The FC own this reserve but have a management agreement with the SWT. Total area of the reserve is 122ha and it lies on both sides of the Ryvoan Pass which runs NE and SW.

Stocking is good on the east facing slope but on the west face of the pass stocking

is regular but much more open and growth much poorer, due to scree slope conditions. Plantations of various species lie immediately adjacent to the South while the reserve is completely open from the NW to the SE.

Isolation: Contamination is very likely from large areas of planted SP immediately adjacent or within 50 to 100m from West to South. It is suspected that the prevailing winds from the SW sweeping up the Pass would bring considerable amounts of pollen - not always of native (local) origin (Steven & Carlisle).

Regeneration: Natural regeneration is occurring in many places throughout the reserve particularly at the lower reaches of the forest and along the track through the Pass. It is of some concern that this abundant regeneration along the valley bottom may indeed not be pure if contamination is as serious as suggested under the last heading (Isolation).

Along the steep South facing slope of Meall a Bhuachaille some considerable distance from the upper edge of the reserve at approximately 500m to 600m there is considerable quite dense regeneration and an example of the 'moving forest' (Dunlop). The distance from the edge of the forest raises the question of just how far seed can be blown by wind alone. The suggestion has been put forward that it has been blown across the top of hard frozen snow (Gill - Dunlop).

Sampling: (154 trees) Commencing the collection on a transect from the SW end of the reserve indicated a good cone crop but thereafter prospects were poorer and many trees had no cones. Further transects were necessary and a thorough coverage was completed across the middle, top and lower edges of the wood, with a small sample from the steep scree slope to the East of the Green Loch (an lochan uaine) below Creag nan Gall.

Recommendations: Even with obvious grazing, regeneration is reasonable though a deer fence would undoubtedly ensure even better natural establishment.

Contamination as I see it is a major problem here and in the long term consideration might be given to establishing a wide buffer zone to the South or South-west by removing all unknown and non native local pine. Firstly however an inspection of the Ri records should be made to determine the origin of as much of the planted pine as possible.

General: The extremely steep and difficult scree slopes to the East of the Green Loch were of considerable interest and it was felt that the population may be of a distinct and previous generation. This concept is based mainly on bark type related to age (Steven & Carlisle). The trees are certainly growing under extremely testing conditions and may well be naturally selected in this respect.

Records and Steven & Carlisle's work confirm a much larger native pine forest at one time and it is to be regretted that so much planting has been introduced. Considerable fellings have also reduced the "largest and best quality fir-woods in Scotland" (Steven & Carlisle).

In the words of a local bard "our ears were stunned by the crash of falling trees and the clamour of the Sassenachs" (Forsyth 1900).

IV SHIELDAIG (Private - NCC interest)

In spite of several major fires over the years (indeed perhaps because of) this native woodland is the most successful in terms of natural regeneration and thus conservation. The largest area of pinewood faces west and is well stocked for the most part with trees from seedlings to 200 years old. Effective pollination should be very good throughout.

The wood also stretches out for some distance in a thin band along the Applecross Road and a third arm faces North as the hill bends to the East above Shildaig village. This third extension is poorly stocked and regeneration is also poor.

Isolation (together with Barrisdale): This is probably the most isolated native pinewood in Scotland with no known contaminant pollen source within at least 4km. However within very recent times monoterpene analysis was carried out on the trees covering Shildaig Island and the results indicated very strongly that the source was not Shildaig but most probably interior North or North-west or possibly central Speyside (G I Forrest - 1987).

This small compact pollen source is not considered critical as it lies some 350m off-shore and some 850m from the north edge of the main woodland. Cross pollination within the population considered very good.

Regeneration: As mentioned already natural regeneration is good almost everywhere. Grazing is much in evidence but nevertheless many trees have 'got away' and there is a great variety of age structure. Also on the southern edge, along the Applecross road and above the upper limits of the forest there are large amounts of browsed but surviving regeneration.

Sampling: (204 trees) Several transects were made along and up and down the slopes also along the Applecross road and a small sample from the Torridon Road section (21 trees).

Adequate transects were very difficult to maintain along the mid upper parts of the main wood due to steep cliffs which were covered with pine but impossible to reach (or at the best very difficult).

Recommendations: In almost all respects this old remnant woodland is the most assured for long term conservation with good regeneration, good health, good stocking and adequate cross pollination and with virtually no contamination. The only recommendation might be gradual enclosure to let grazed regenerations get away.

V STRATHVAICH (Private - NCC management)

A small compact moderately well stocked woodland along the Western edge of Loch Vaich ending abruptly at the Allt Beithe burn.

Strangely enough this old remnant woodland has been missed out on the OS map 1:50000 second series.

Steven & Carlisle cast some slight doubt on the status of this wood though all the suggestions are that it is native, including the reference to Druimean Giubhais (Ridge of the Pines) further down the glen and Blaeu's Atlas (1654) shows 'trees' near this site. However it was noted that a great many old pine stumps now covered with a cap of Rhacomitrium occurred particularly at the more open Southern end of this area. These must be incredibly old and if one assumes that an average Scots Pine will reach an age of at least 300 years before dying then to reach a stage when all that is left is a moss covered stump must surely be a time span in the region of 600 years, long before any planting was done in remote areas.

A very few scattered pine occur south of Allt Glas Toll mor but the main woodland starts north of this burn.

Isolation: Very good isolation and second only to Shildaig. A small plantation was seen just over 2km to the South-east, but no other known contaminant source is found before reaching large plantings at Longart over 7km away to the South-east. Cross pollination should be adequate to good.

Regeneration: Apart from a very few plants growing on the steep gully sides of

Allt Beithe there was no regeneration seen. There is however a very large deer presence and on leaving the glen in the evening large numbers were seen almost refusing to move off the track.

Sampling: (153 trees) Very easy as most of the trees had low crowns and good cone crops all within reach of the high pruner. Because of this and the comparatively even topography no help was required with this collection which was completed in 2 man days. Three transects were made, upper, middle and lower.

Recommendations: The NCC have a management agreement for this woodland which involves the erection of a deer fence over a large part of the area, and I understand this is to be done quite soon.

Once the deer have been excluded there would appear to be no reason why natural regeneration should not establish quite readily. The majority of the trees are very healthy and only a few have or appear to have reached their life span. Prospects therefore are very encouraging for the conservation of this old woodland which seems well placed to keep its own genetic identity and purity.

VI CONAGLEN

The Conaglen population is largely one complete woodland facing North and stretching for approximately 3km below Druin Leathad nam Fias and South of Corriarach across the river Conar.

Stocking is reasonably good and cross pollination should be quite adequate throughout the whole wood. The majority of the trees are healthy and no trees of great age were observed.

Isolation: There was no observed contamination source for some considerable distance, the nearest possible area being from an east to south-easterly direction at a distance of some 2km or more. Purity of this population can therefore be considered very good.

Regeneration: Very little regeneration was seen, however the Estate fenced off a 20 ha block about 3 to 4 years ago and regeneration is now very much in evidence throughout the block with many seedlings from one to three years of age seen. An excellent example of what fencing alone can achieve.

Sampling: Four transects were made at high, intermediate and low elevations covering the entire 3km area. The cone crop was light to poor with a very low seed yield.

Recommendations: From the excellent results obtained by fencing so far it would seem prudent to continue gradual enclosures over as much of the old wood as possible

General Notes: This collection was conducted in close co-operation with Estates Agent Mr R T Sidgwick of West Highland Estates who wished to make his own seed collection. Three employees were made available for the work which resulted in a very good sample for each party.

VII GLENTANAR (Private - NCC management)

The Glentinar pinewoods constitute probably the largest continuous area of native pine forest in private ownership and at its widest part stretching for approximately 7km. Stocking overall is very good and even in the very old trees health is also

good. The age classes cover the full range, with some of the suspected oldest trees seen anywhere in the native woodlands. Form also varies considerably with several areas of superb form eg Craig of Woodend and Frederick's Walk.

Isolation: Little appears to be known about contamination from foreign source of pollen though literature and nursery records (Ben Reids) indicate very strongly that "local" pine has been in use for seed and timber from at least the beginning of the 17th century (Steven & Carlisle). If one assumes that the main block of Glentanar from Glentanar House east to Tower of Ess, west to Etnach and south to Craigmahandie is all of native origin then the only contamination of any significance is likely to come from the North (at least 3km). Within the population cross pollination should be very good indeed.

Regeneration: Taking the forest as a whole the regeneration both natural and artificial is good and would seem to be - in the long term - assured by felling and by scarifying.

The NCC has a management agreement with the Estate and has done and is doing a great deal of work on conservation.

On very high ground to the south regeneration appears to be spreading outwards away from the edge of the old forest.

Sampling: (246 trees) Because of the very large area involved five areas were selected and sampled separately but even at this the coverage was questionable and perhaps more ideal would have been two further sample areas to cover Allachy and Bad na Muic at the lower north and west ends.

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| Sample | 1) The Drum |
| | 2) Gairney |
| | 3) Glentanar - Water of Tanar |
| | 4) Fir Hillock |
| | 5) Craig of Woodend |

Number 5 was a sample from 15 recently blown trees.

General Notes: There was a very noticeable increase in the numbers of cones per tree and numbers of trees with cones throughout the upper limits of the forest where the cone size appeared to be larger than average also. At the lower levels especially above Frederick's Walk and below the Burn of Allnaharvy it was difficult to find any trees with cones.

The extreme western end of the forest at Fir Hillock was very interesting in that according to the bark type I would suspect that it might well be one of the oldest parts of the Glentanar native woodland.

This is undoubtedly an important and valuable native woodland whose continued conservation seems assured and genetic purity also appears reasonably safe especially so south of the Water of Tanar which covers the largest part of the total area.

VIII RANNOCH (FC - NCC involvement)

The Blackwood reserve faces north and consists of one large continuous block within the main forest all of which is natural native pine either by natural regeneration or planted or seeded regeneration. A small adjoining area of native pine on the extreme western boundary is privately owned.

Isolation: Only Rannoch origin planting has been allowed in the whole of the main block, any contamination is only likely to come from across Loch Rannoch 1.5km at the nearest point, all other sources lie 3 to 6 km west, south and east. Contamination

could therefore be considered reasonably low. Within the population cross pollination should be very good.

Regeneration: A great deal of work is being carried out in co-operation with the NCC with new fencing and careful detailed monitoring within the reserve. Natural regeneration overall is reasonably good and large areas have been established within recent time using Rannoch material outwith the reserve.

Sampling: (152 trees) Due mainly to poor weather conditions only two sample areas were covered with one transect in each.

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| Sample | 1) Below Cross Craigs at 450m |
| | 2) At low level above main road between Blackwood Cottage and Rannoch School |

This is not considered sufficient coverage and two more transects would be required.

General Notes: A large area of planted native pine above Dall Burn was inspected with ranger David Lambie which had been suggested as a possible collection area on account of the heavy cone crop and ease of collection from the young trees. However on a cut sample from 15 trees over a reasonably wide area not a single full seed was found. This reflects very much on the age of the crop which had not yet come into the male flowering stage and on the undoubtedly poor pollination year of 1986.

Apart from fire the very long term conservation of the Black Wood is well assured. However even in the event of some huge and terrible fire the old trees are likely to escape and regeneration would very likely follow. Herein I think lies another natural conservation safeguard as seen at Shildaig for example.

IX BARISDALE (Private)

This old remnant woodland is by far the most remote and difficult of access of all the Scottish native woodlands, being at least 12km on foot from Kinloch Hourn and 6km by sea from Arnisdale.

Isolation: Partly because of its position in a steep sided sheltered glen and certainly because of its sheer distance from any other pine (at least 10km in any direction) this woodland must be the least affected by contamination and, genetically the most pure.

Regeneration: There was little or no regeneration seen and with no fencing and a large deer population the long term prospects for survival and conservation are very poor and only odd single individuals growing on rock faces or steep gullies out of reach of the deer are likely to survive.

Sampling: (60 trees) A 5km transect from the most easterly end of the woodland at the head of Glen Barisdale to just south of Doire Asamaidh at the western end gave a good coverage of the population in area but unfortunately the cone crop was poor and only 60 trees could be sampled, which is insufficient to give a good genetic base to the collection. No samples were taken in the Gleann Unndalain and Mam Barisdale area.

Recommendations: Fencing is the first consideration though unlike many of the old woods the trees at Barisdale are relatively healthy and not of great age, so enclosure is not urgent and small areas fenced over a long period of time would perhaps be the best solution.

General Notes: The best stocked and largest block lies to the south side of Glen Barisdale at Allt Slochd Nighinn Bheathain where inter-pollination should be

quite adequate, also at Doire Asamaidh. However there are at least seven other small poorly stocked and scattered remnants where cross pollination is not likely to be very good. These were not sampled.

There are also about four well separated small areas of pine along the South shore of Loch Hourn and according to Steven & Carlisle only scattered pine along the north side of Loch Hourn. None of these latter areas were seen or sampled. Of interest and considerable conservation importance was the occurrence of some of the largest tree junipers ever seen in the native pinewoods growing in the west half of the largest block above Slochd Nighinn Bheathain.

The shoot samples for monoterpene analysis resulted from very close co-operation with Wester Ross FD who supplied one forester Jim Livingstone and a forester from Field Survey Graham MacBryer.

DISCUSSION/SUMMARY

Sampling:

The practical difficulties of sampling for seed in order to achieve a good cross section of the population with a broad genetic base are discussed. Transects must cover all ground variations, all elevations and all aspects with sufficient numbers of individuals sampled to obtain adequate expression through the seed of the genetic variation available.

a) Number: A figure of 150 sample trees has been suggested and in populations which are reasonably compact and no more than about 50ha this figure is probably sufficient. However I would suggest that for very large areas this is not an adequate number eg Glentanar. If we accept that 3 sample trees/ha is a guidance figure this would mean the same sampling intensity for each woodland then Strathvaich which has an area 38ha would have a sampling intensity of 114 (instead of the 153 sampled). Queens with an area of 122ha would require a sample of 366 trees.

b) Transects: I would further suggest that 3 transects would normally be used to overcome to some extent

- 1) Mother tree grouping
- 2) Pollen spread throughout the population
- 3) Population drift.

In very poor 'cone' years the above system becomes more difficult to implement in that more transects may have to be employed in order to achieve the amount of seed required. An example is the Cougie reserve of 43ha where 7 transects gave only 130 trees with every tree on a line bearing cones sampled. One transect would have meant only about 20 sample trees.

Actual transect lines should be randomly selected but must fully cover the sample area and at all elevations and aspects. It must be accepted that straight lines are impossible to follow due to cliffs, ravines, burns, lochans or peat bogs to name but a few of the obstacles.

c) Techniques: There are physical and technical limitations in the sampling of occasional trees on the transect line for the following reasons:

- 1) Trees over 8-9m in height (beyond the reasonable reach of pruners) which carry their cones on top of or in the 'interior' of the crown which by the nature of their position cannot be dislodged by shooting;
- 2) Trees as above which carry a thin scatter of single isolated cones very few in number, each of which (minimum number 10) require shooting and each one possibly lodging in the crown.

d) Cone size: Cone size varies enormously between trees however within individual trees there is also a degree of variation in size and very small cones (well below average for the tree) should not be collected as they are unlikely to have any sound seed.

Cone opening: The number of cones which fail to open in the kiln varied enormously between the nine different lots, with no clear pattern emerging as regard time of collection or geographic position. The reasons for some cones not opening is unknown and, although a few do have seed, in the main they appear to be empty.

Yield: The yield of seed appears to increase in collections made during March/April, but not on very reliable evidence. See Appendix.

e) Pollination and contamination: Little can be found on the subject of pollen

dispersal in Scots Pine and no reference to critical distances beyond which contaminant pollen has little or no effect or indeed what is the maximum distance between trees which is acceptable within a native pinewood for adequate cross pollination. Our inadequate knowledge of the pollen crop of forest trees is a great handicap to further research on forest tree seeding. (Sarvas 1962)

It is considered that contamination is already having an adverse effect on some of the native pinewoods in that natural regeneration could in several instances be impure due to plantings of 'foreign' SP in the immediate or adjacent areas eg Glenmore.

The abundance of yield of pollen from different parts of the stand also varies (Sarvas 1962).

f) Regeneration: All the evidence suggests that fencing is the first consideration and in many cases it is probably the only necessary step which is widely accepted as the nearest most natural approach to the problem. There are always exceptions to the rule of course and an example of reasonable natural regeneration without fencing is to be found at Shieldaig where although there is some browsing it seems only to have slowed the process whereas in most other cases regeneration has been or is being completely erased regularly each year.

After fencing has been completed for a year or two it is surprising just how many seedlings can be found, given light of course. After all we are not looking for full stocking only very odd individuals or scattered seedlings of varying ages, where it might even be considered not too unnatural to carry out some hand weeding in rank heather and even apply a sprinkle of phosphate.

If all else fails it may well be justified to plough and plant or scarify but I consider these extreme measures and very unnatural in a true conservation sense and certainly unacceptable as regards the process of natural selection.

It is unfortunate that this collection year has been a poor cone (and seed) crop and most of the yields have been well below the minimum seed requirement ie 15000 sound seeds.

in good seed years collections over one year are possibly adequate (even this is debatable) but certainly samples over a number of years should be at least the standard Research practice as there is no doubt that many of the trees which carried no cones or too few cones in the first year could well be sampled in the second. Also there are the differing climatic effects on pollen availability, ripening and dispersal in any one year, which undoubtedly has a considerable influence on the seed content and number per cone. I feel it is of the greatest importance that these population collections are thoroughly and soundly sampled, and suggest that each one is re-sampled in 1988.

M T T Phillips
18th May 1987

SUGGESTIONS FOR AVENUES OF RESEARCH IN NATIVE SCOTS PINE

1) Study of cone opening and size in relation to full seed content:

There could obviously be a very large number of points for such a study but the most important might be:

- (a) Cone size
- (b) Opening/non opening/Degree
- (c) Yield of full seed
- (d) Origin
- (e) Time of year (collection)
- (f) Elevation
- (g) Position in crown
- (h) Individual tree variation

I would suggest that (a) to (e) might well be carried out at Alice Holt Extractory this year. As regards (c) above further work is needed to overcome the non opening of cones problem.

2) Study of Pollen Dispersal in native Scots Pine woodlands. Critical between tree spacing for effective cross pollination and minimum safe distances from contaminant sources:

This should be a University study and in my opinion an extremely important one which could perhaps be extended to our seed orchard programme.

- (a) Dispersal
- (b) Distances
- (c) Period and maximum-minimum shed
- (d) Amount
- (e) Between tree distances
- (f) Crown coverage in relation to pollen amount
- (g) Weather factors, prevailing wind, temperature, etc.
- (h) Individual tree differences, group differences

3) Further monoterpene studies relative to the age of different parts of the same population.

4) University study of previous populations and age through the carbon dating of old hummocks and sump remains as a guide to the sequence and drift of the Pine Forest.

Despite the comparatively restricted and practical nature of this project a considerable number of people were involved both with advice and practical help. I am very grateful for this abundant help.

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NCC ABERDEEN

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DIGBY BULMER)

JOHN LYALL) for excellent willing and knowledgeable practical help.

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Shieldaig

MR GREG - To the owner of the Estate to whom sincere thanks are due.

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LEA MCNALLY, National Trust for permission.

ANGUS MACRAE (from Wester Ross FD) for practical help.

Conaglen

MR GUTHRIE - grateful thanks are due to the owner for permission to collect.

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MIKE DIXON)

JOHN MAITLAND)

JOHNNIE MAITLAND)

) Estate staff who gave excellent practical help.

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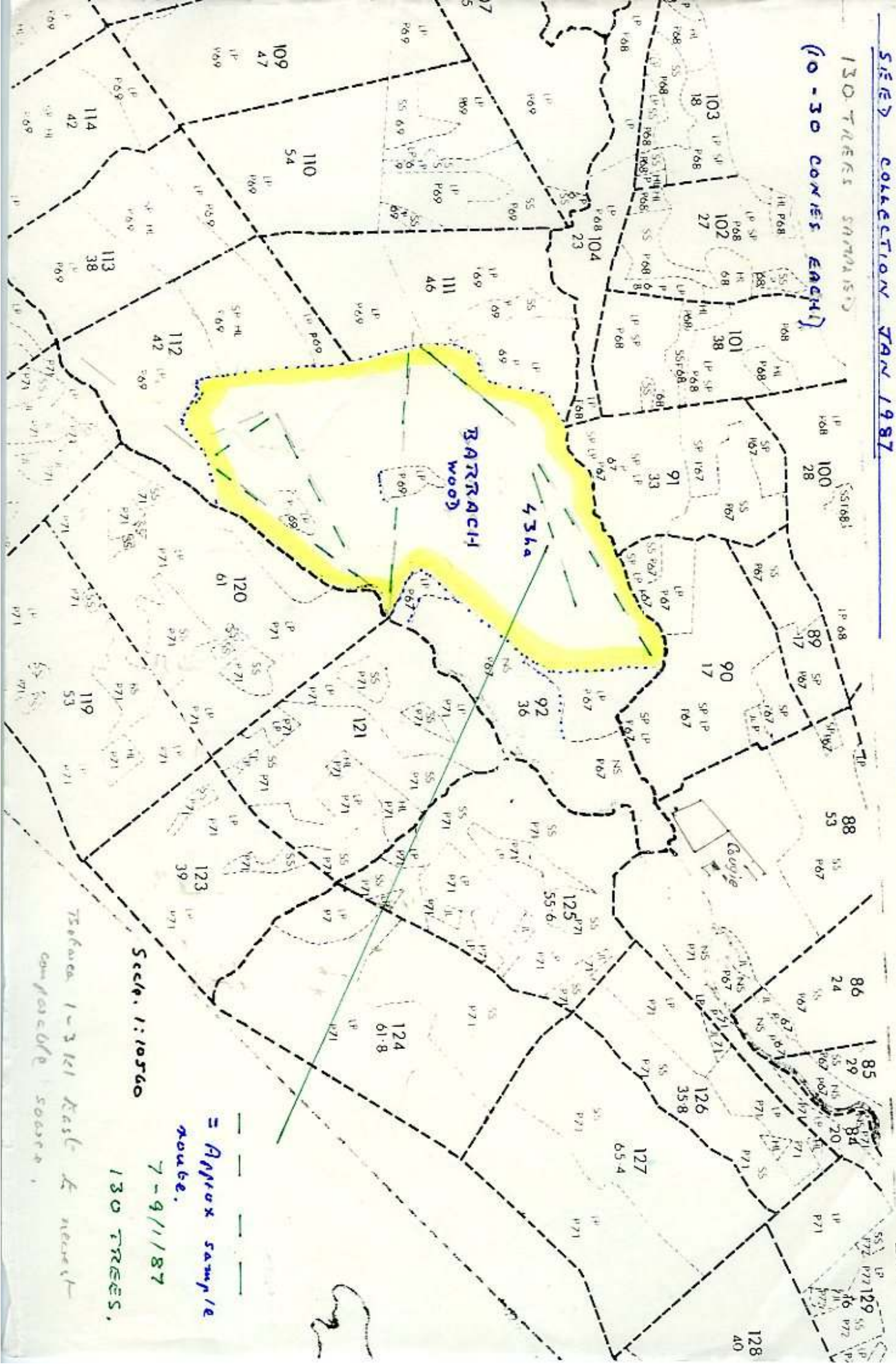
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COCUIE S.T. NATIVE RESERVE.

SERIED COLLECTION JAN 1987

130 TREES SAMPLED
(10-30 CONES EACH)



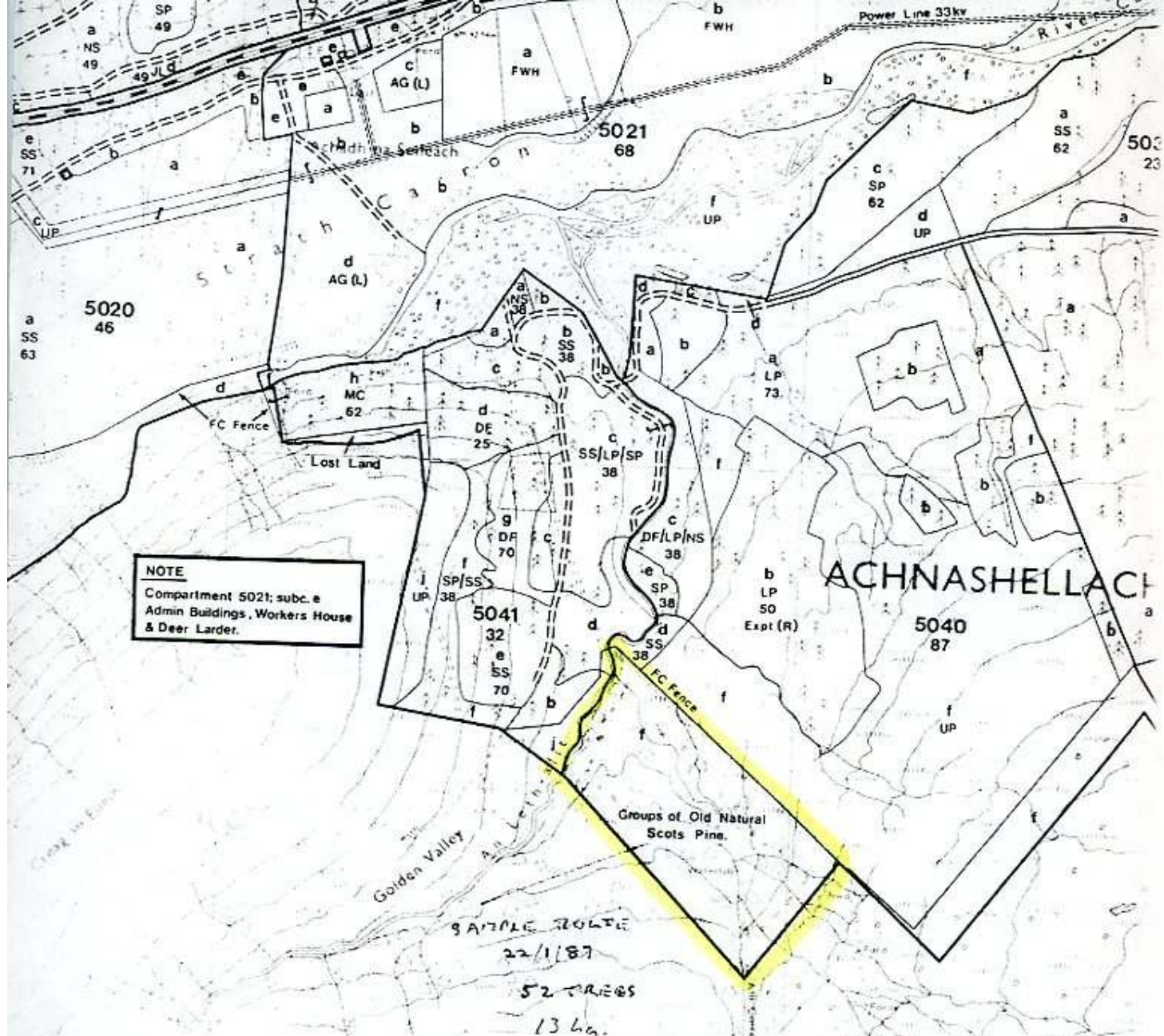
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= Approx sample route.

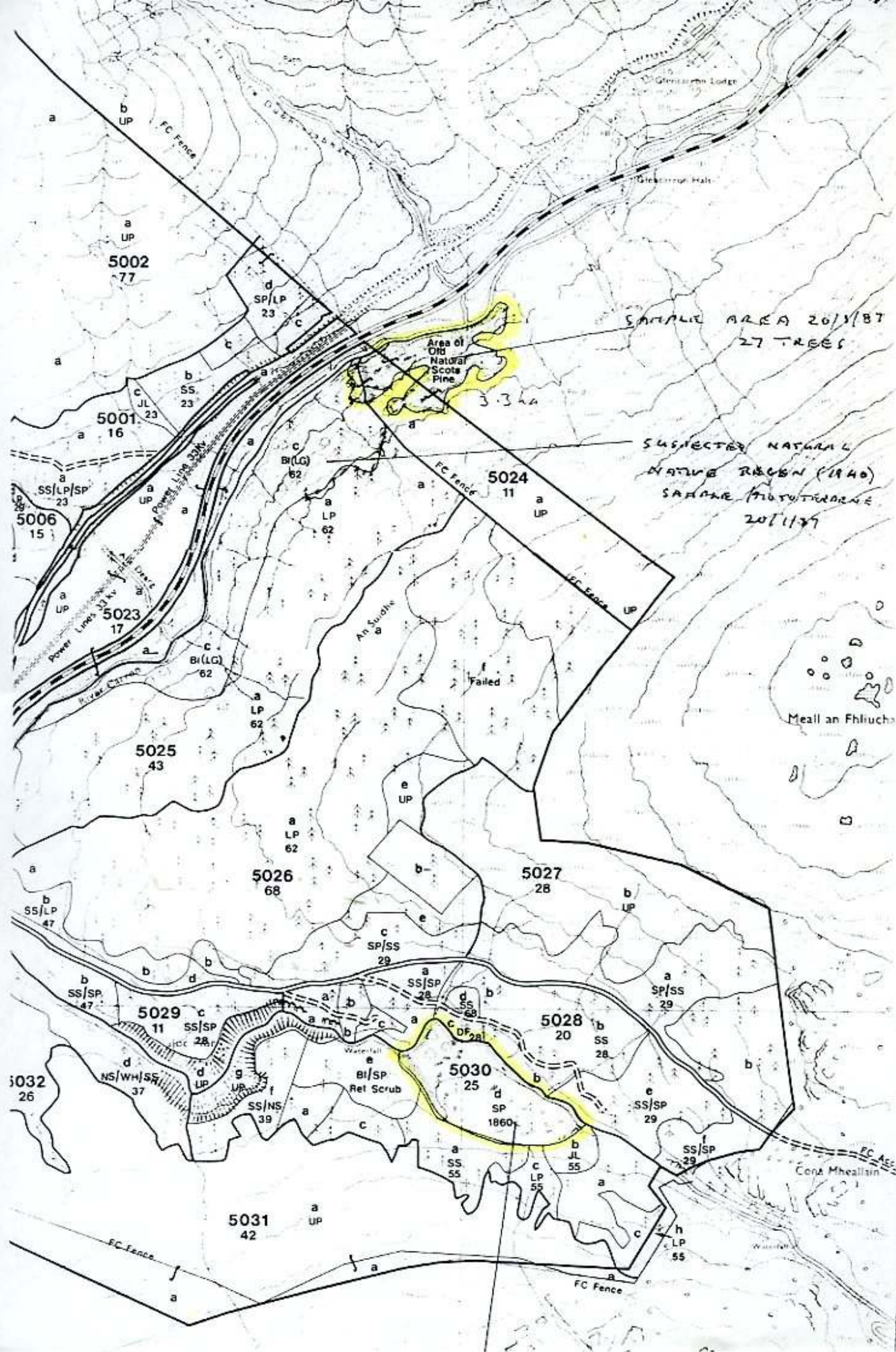
7-9/1/87

130 TREES.

Trunks 1-3111 N.E. & N.W. compass rose.



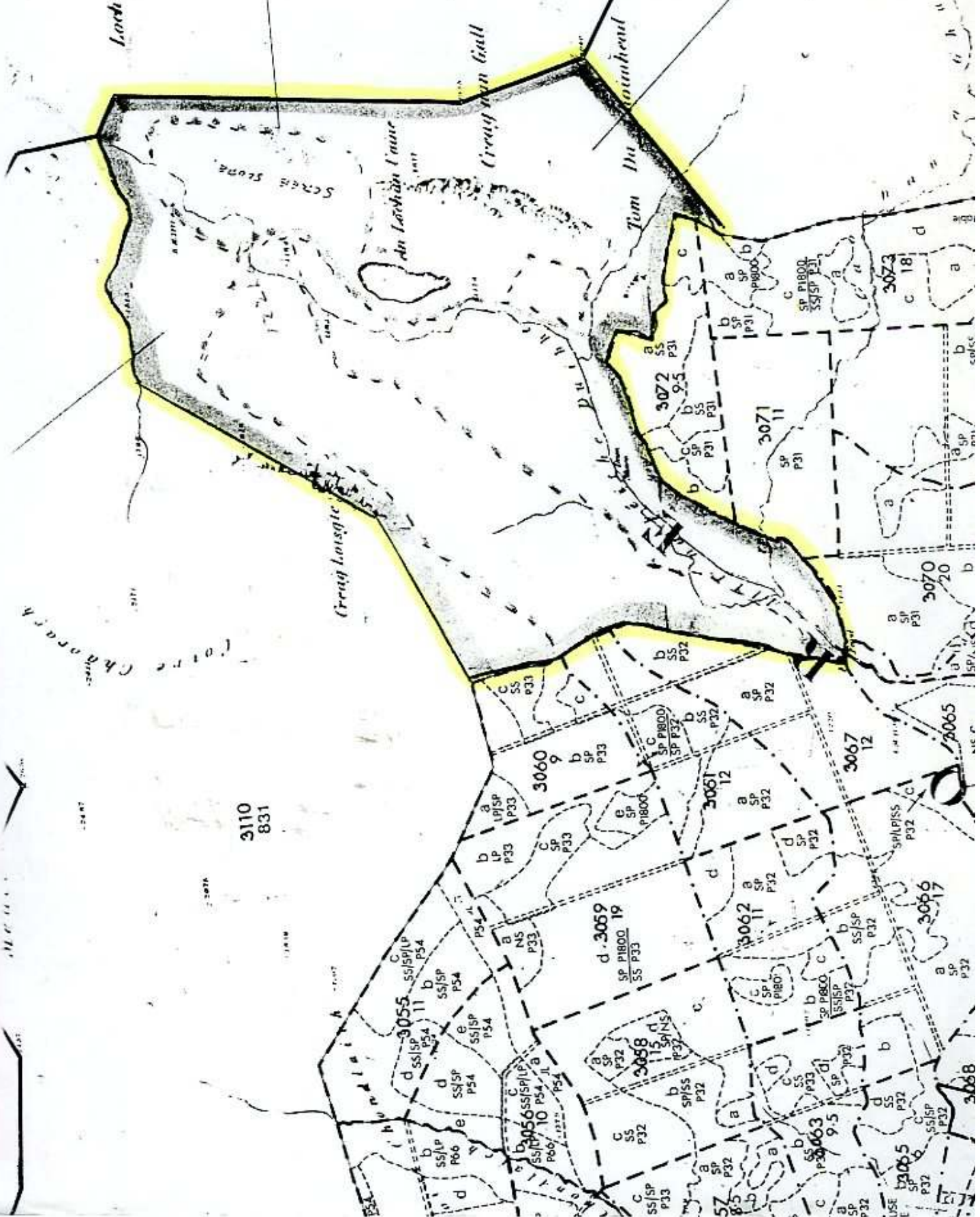
WESTER ROSS FOREST DISTRICT
Forest or Survey Area **ACHNASHELLACH**



Loch a' Ghairbh-choir

SAMPLE TROUT
26-29/1/87
154 TREE

TOTAL RESERVE AM
122 ha



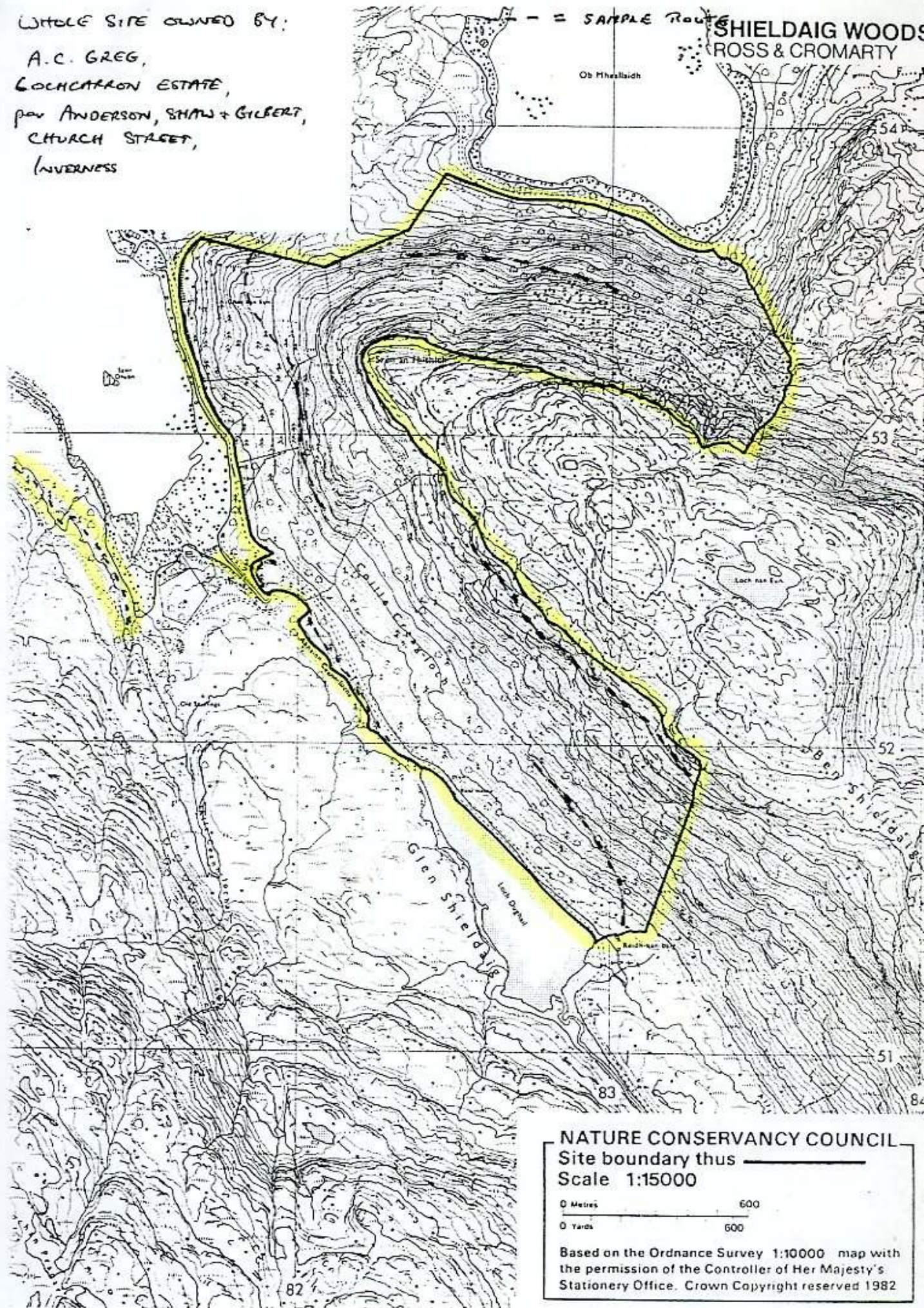
WHOLE SITE OWNED BY:

A.C. GREG,
LOCHCARRON ESTATE,
per ANDERSON, SMITH & GILBERT,
CHURCH STREET,
INVERNESS

- = SAMPLE ROUTE

SHIELDAIG WOODS
ROSS & CROMARTY

Os Mheallaidh



NATURE CONSERVANCY COUNCIL

Site boundary thus ———

Scale 1:15000

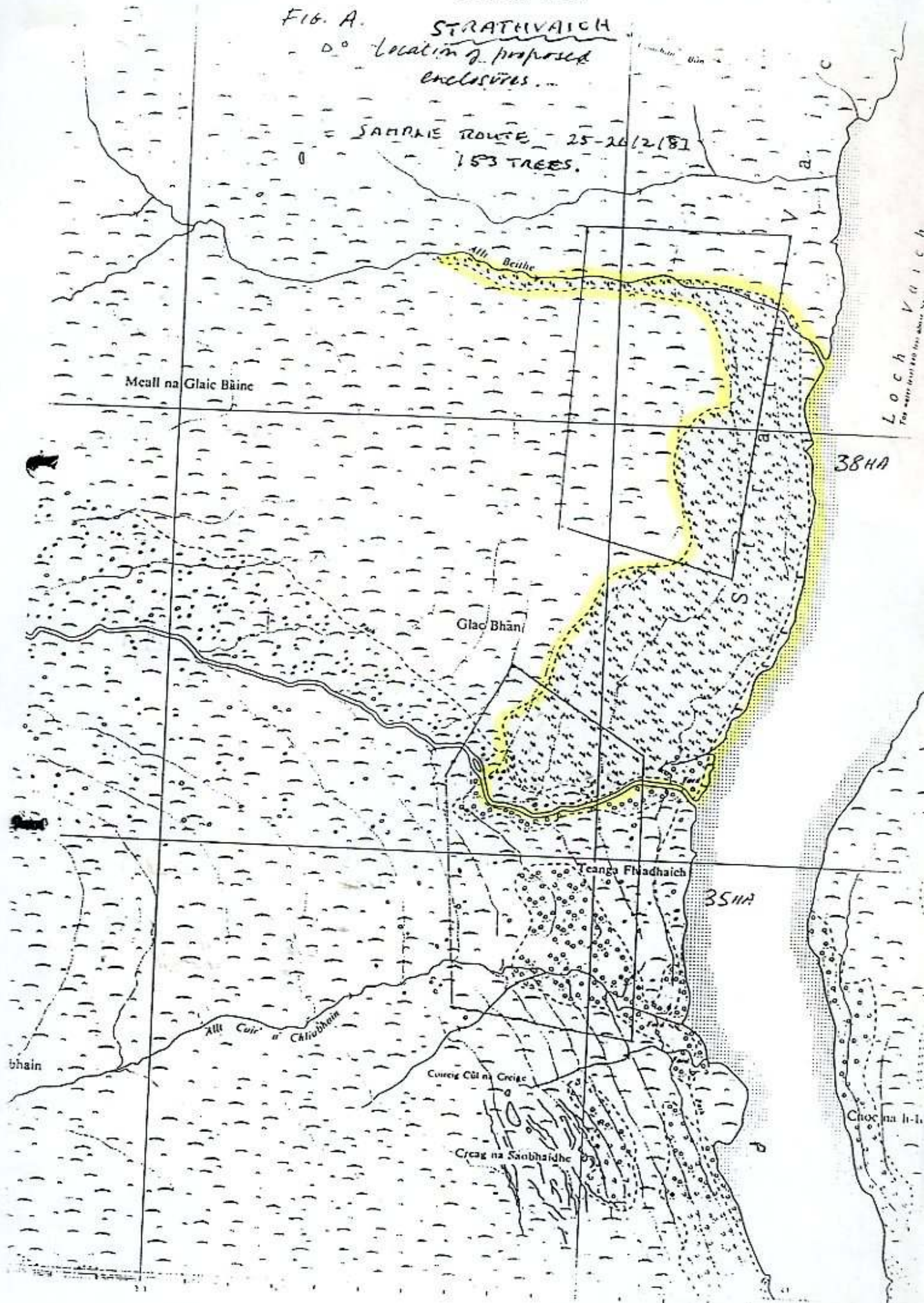
0 Metres 600

0 Yards 600

Based on the Ordnance Survey 1:10000 map with
the permission of the Controller of Her Majesty's
Stationery Office. Crown Copyright reserved 1982

Fig. A. STRATHVAICH
 D^o Location of proposed
 enclosures...

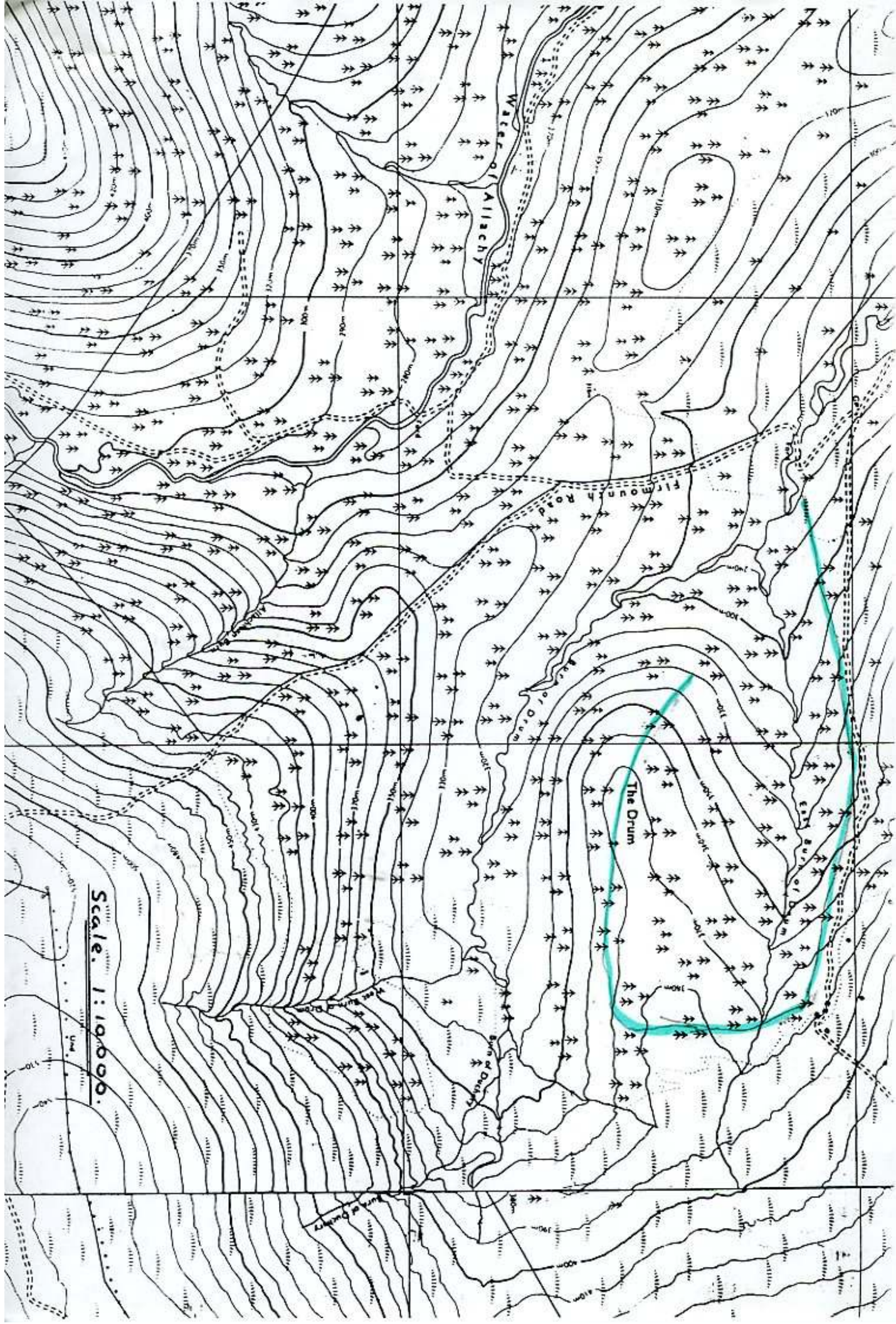
SAMPLE ROUTE - 25-26/2/81
 153 TREES.



Scale. 1:10 000

THE DRUM

10.3.87 - 86 TREES.



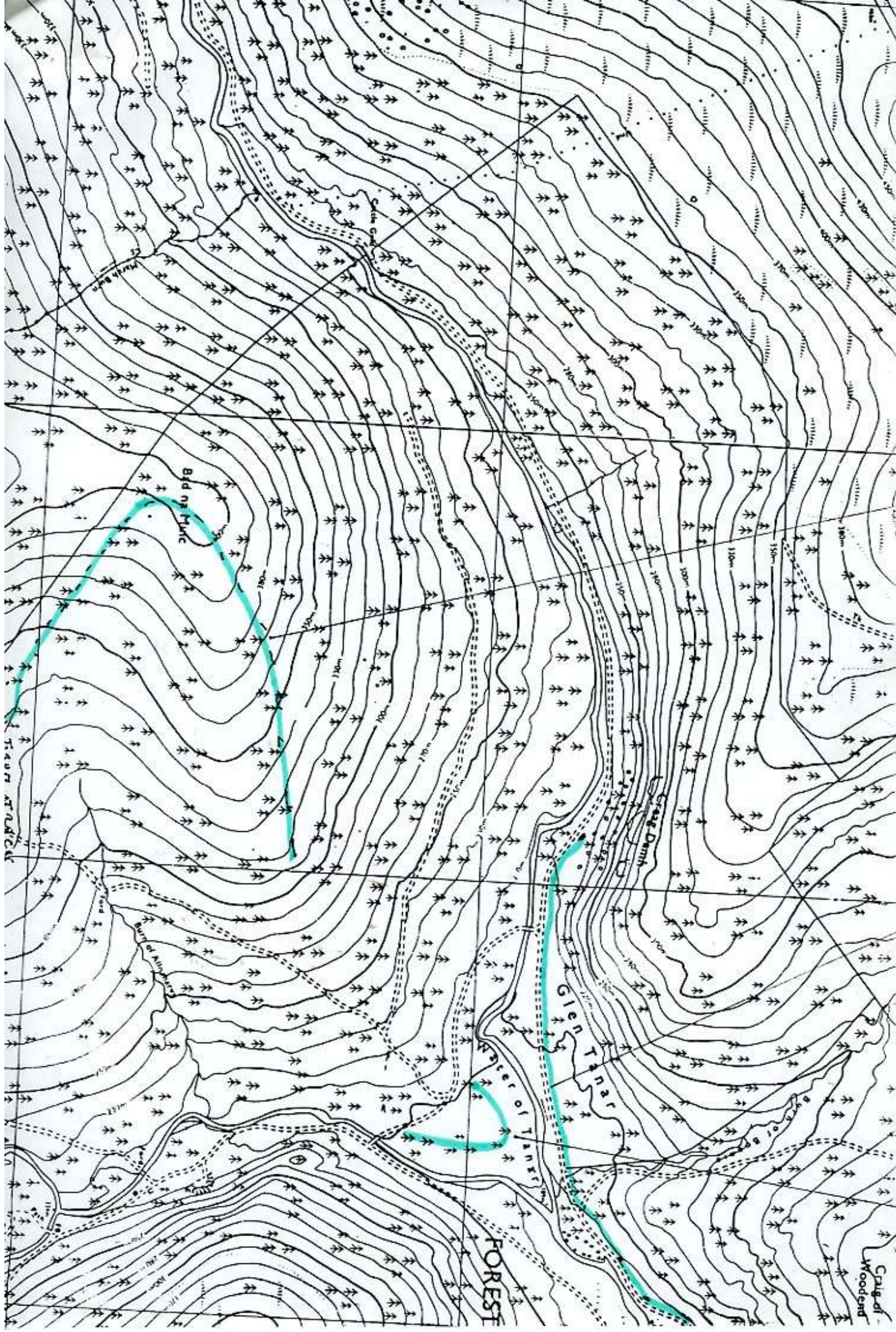
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Gairney.

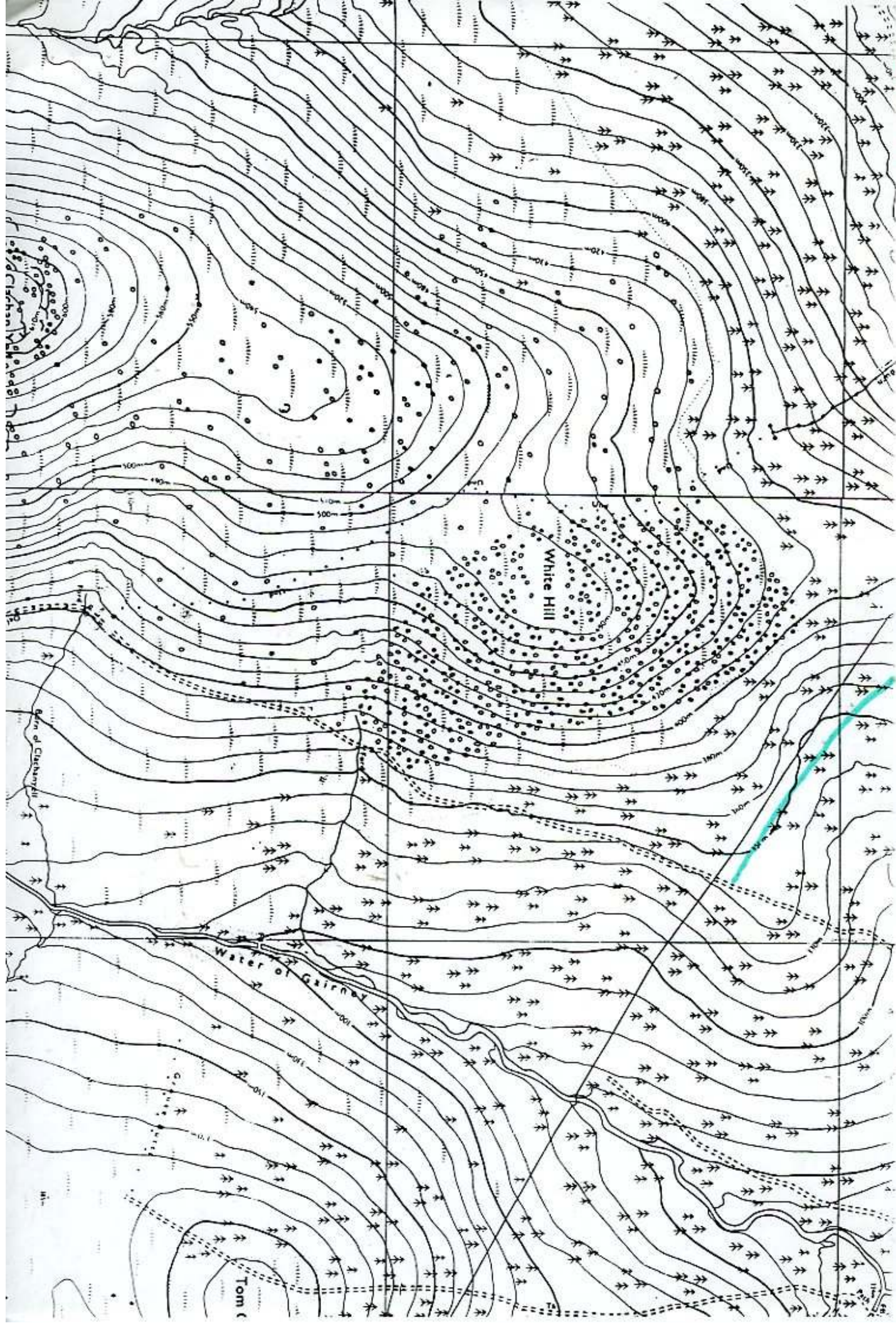
11.3.87.

49 TASES.

Glen Tanart - 30 TASES 12.3.87.



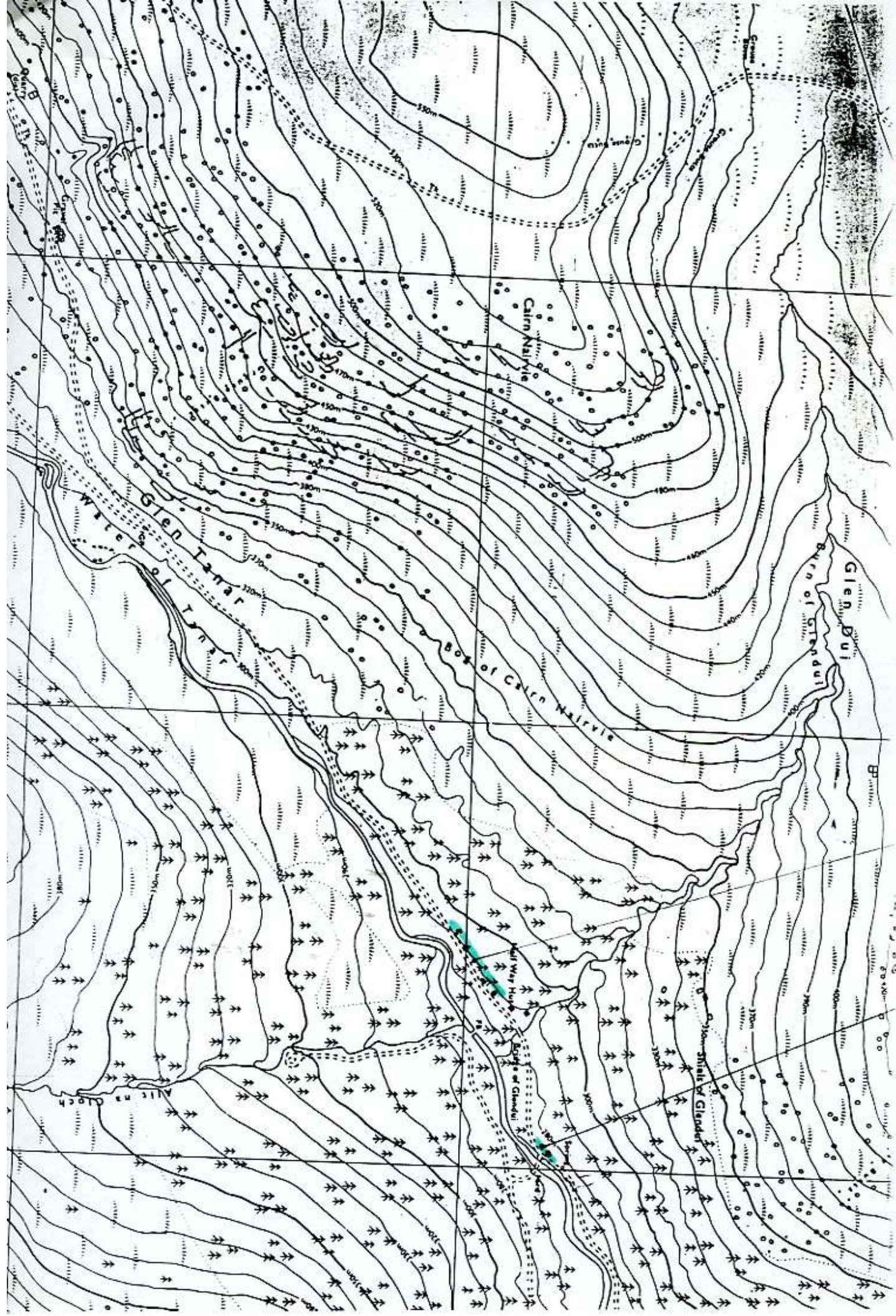
Gairney.



WATER OF TANAR.

7 TREES.

12.3.87.

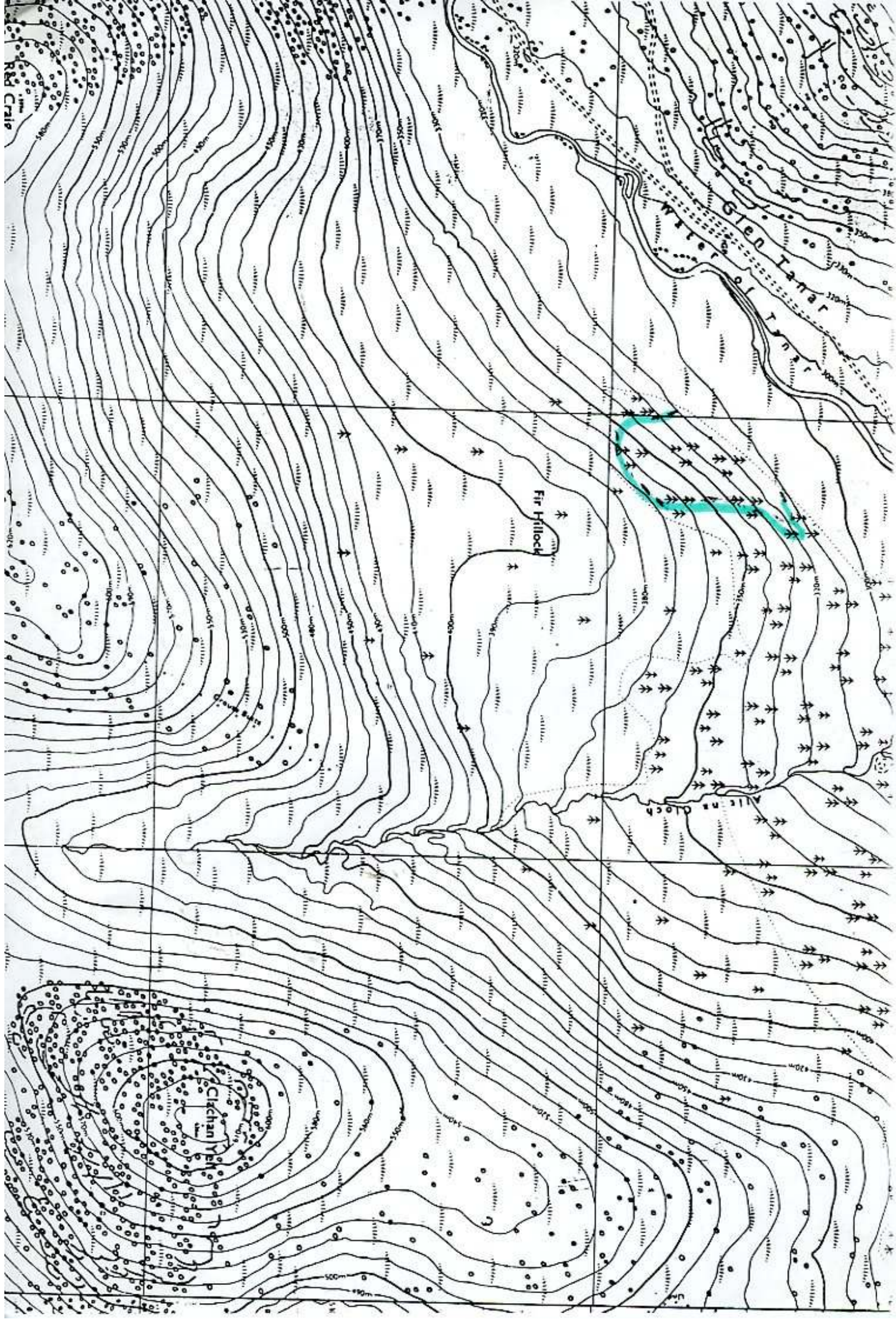


WINTER GLENTANATE.

- TELLER HILLOCK.

12.3-87.

53 TRAILS.

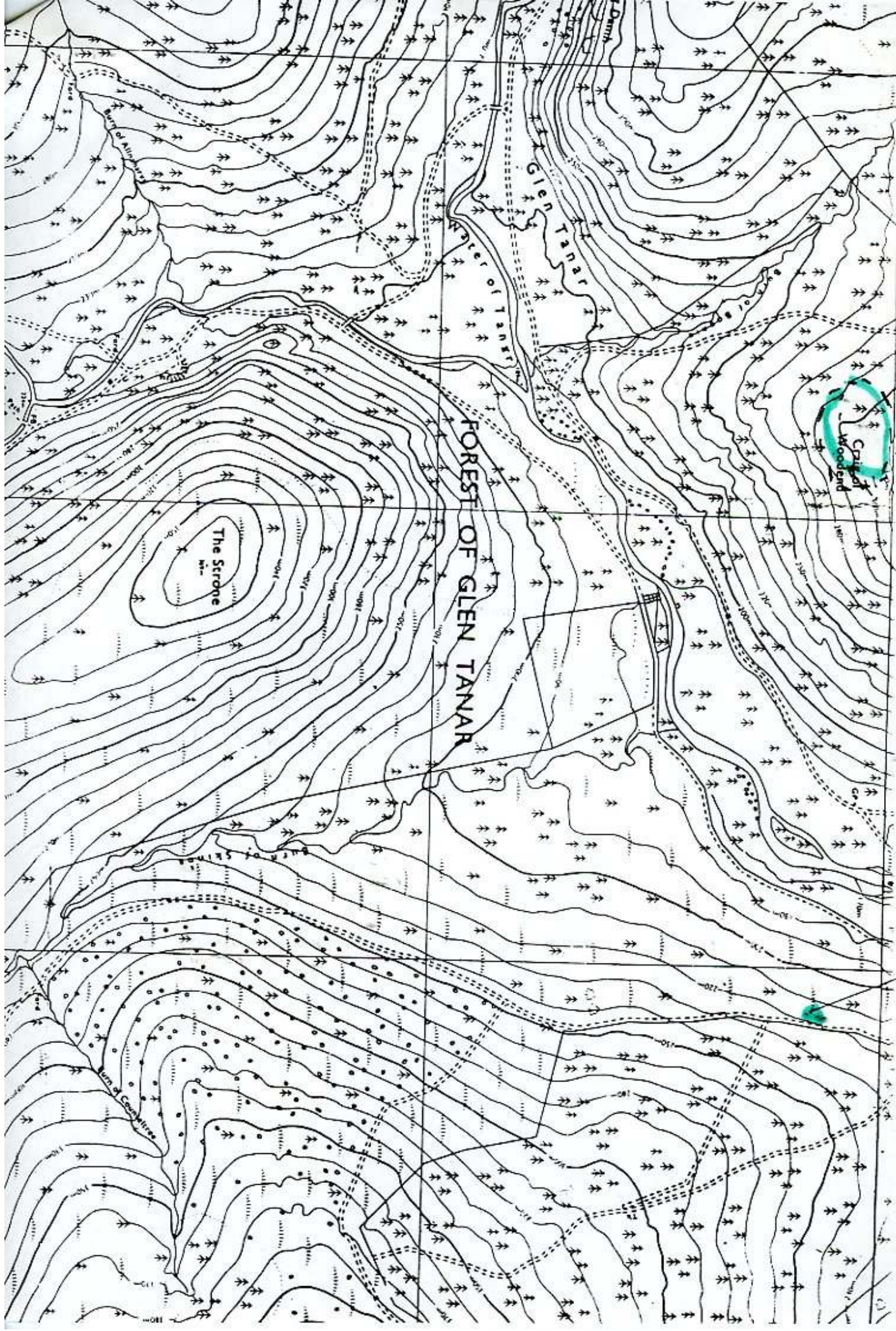


CRAIG OF WOODEND.

15 TRAFES

21.3.87.

10 TRAFES. 10.3.87.



RANNOCH. 152 TREES - 24.25.3.87.

